(R7) Texas A&M University (TAMU) – College of Engineering - R7 - Model Development for Risks posed by COVID-19 on U.S. Trade Supply Chain Infrastructure.

Please list PI and other key technical and project personnel (and key collaborators) in the table below

Name	Role	Position Title	Affiliations
Zenon Medina-Cetina, PhD	PI	Associate Professor	TAMU Engineering Civil & Environmental Engineering
Gregory Pompelli	Co-PI	Director	Center of Excellence for Cross-Border Threat Screening and Supply Chain Defense (CBTS)
Matt Cochran, DVM, MIA	Co-PI	Director for Research	CBTS Institute for Infectious Animal Diseases (IIAD)

I. Objective/Purpose: *Include a short/one sentence problem statement.*

1. To generate a *risk-guided platform* to provide access to datasets, predictive models and experts' opinions, to produce evidence-based support on the causes and effects posed by COVID19 on the U.S. trade supply chain infrastructure
2. To formulate a *comprehensive risk assessment model*, mapping qualitatively participating processes needed to simulate 'prognosis and diagnosis scenarios' of social, economic and environmental impacts posed by COVID19 on the U.S. trade supply chain infrastructure
3. To generate *risk-mitigating strategies based on resiliency and sustainability* supported by evidence collection and the associate risk assessment model, to address causes and effects posed by COVID19 on the U.S. trade supply chain infrastructure

II. Research Results:

There have been no changes from the approved workplan.

Milestone 1 – Project Kickoff
Kickoff meeting held on June 22nd of 2020

Milestone 2 – Data Acquisition and Management Plan in Place
Data Acquisition and Management Plan submitted for revision on September, 2020

Milestone 3 – Risk Guided Platform
Met with contractors and TAMU personnel for the identification of technical specifications of the Data-Lake System, as well, as the procedures for its implementation and operation. Additionally, the installation of the on-premise Data-Lake System, and the acquisition of Cloud Services were completed.

Milestone 4 – Risk Assessment Model
Developed a Version 0.0 of the Bayesian Network Model for Risk assessment through the identification of variables, and dependencies, for each risk component (i.e., threats, vulnerable systems, impact metrics, and states of risk) from literature review and other sources of evidence. This version of the model consists of a minimum viable model and an extended version for different spatial configurations of the Supply Chain entities.

Milestone 5 – Risk Mitigating Strategies
As part of development of Milestone 4, an initial set of mitigating strategies have been identified. These mitigating strategies correspond to measures oriented to reducing the threat intensity, reducing the supply chain's vulnerability, and/or reducing the overall exposure of the vulnerable systems.

The detailed list of activities that supported the research results included here, are described in the following section.

III. Performance Discussion:

Weekly updates corresponding to *Output 1* were registered in the form of Power Point presentations summarizing thje project progress by members of the Stochastic Geomechanics Laboratory (SGL). Minutes were captured on a Word document capturing key contributions to each Milestone of the project. Both the Power Point presentation and the Word document were stored in a dedicated Microsoft Teams channel to the project, available to all PIs, graduate students and supporting staff. Content of both documents were used as basis to populate each monthly report. Moreover, the dedicated Microsoft Teams channel allowed SGL's team to collaborate, expedite communications, manage the exchange of information, and improve the archiving of resources among other benefits. Below key contributions by month and milestone.

July

Cross-Milestone activities - M3 (Risk-guided Platform), M4 (Risk Assessment Model), and M5 (Risk Mitigating Strategies).

- Completed student recruitment and hiring process
- Familiarized the students with the contents of the project proposal
- Define research tasks with students

August

Cross-Milestone activities - M3 (Risk-guided Platform), M4 (Risk Assessment Model), and M5 (Risk Mitigating Strategies).

- Reviewed the workplans of related DHS-R projects, and identified the areas of expertise of each group of experts.
- Performed a preliminary literature review on the definition of Supply Chains, the main components, processes and flows, as well as the evolution of Supply Chain and Supply Chain Management concepts.
- Performed a preliminary literature review on Supply Chain threats, and states of risks, associated with COVID-19.
- Identified the intersection of Supply Chains concepts, and the components of the Risk Assessment and Management Framework
- Started the identification of relevant threats, vulnerable systems, impact metrics, and states of risk.

Milestone 3: Risk-guided Platform
Contributing to Task 3: Generation of the platform for curation and sharing of

information collected

- Started the communications mechanisms with subcontractors for the definition of the data lake system and acquisition of components

September

Cross-Milestone activities - M3 (Risk-guided Platform), M4 (Risk Assessment Model), and M5 (Risk Mitigating Strategies).

- Developed a Microsoft Project Management System Project Masterplan
- Started a Communication & Collaboration Environment on MS Teams
- Reviewed Security Protocols and Privileges for everyone involved in the Team
- Submitted DHS Form 11055 - Foreign Background Foreign National Screening Request
- Definition of the mechanism of engagement with other Subject Matter Experts (SME) research groups, institutions, and collaborators, including but not limited to:
    - Anneal Initiative LLC
    - The Food and Agricultural Policy Research Institute at the University of Missouri (FAPRI-MU)
    - TAMU's Center for North American Studies (CNAS)
- Defined point of contact with TAMU's Library Systems to define an ongoing collaboration to setup the Texas Data Repository (TDR) for future publishing and archiving of curated data

Milestone 2: Data Acquisition and Management Plan.

- Delivered Data Acquisition and Management Plan to DHS for feedback and review

Milestone 3: Risk-guided Platform

Contributing to Task 3: Generation of the platform for curation and sharing of information collected

- Met and reviewed the Data-Lake design, implementation, and operation plan with:
    - Contractors
    - TAMU Information Technology Risk
    - TAMU High Performance Research Computing (HPRC)
    - IT Engineering – Server Services
    - IT Engineering – Cloud Services
- Completed installation of on-premise Data-Lake System (Hardware)
- Completed acquisition of Cloud services for the Data-Lake System

Milestone 4: Risk Assessment Model

Contributing to Task 5: Formulation of risk assessment model using Bayesian Networks

- Initial State-of-the-art Literature Review on the World's Supply Chain Research
- Performed Literature Review of Supply Chain Definitions
    - Defined the main terminology and definitions employed in the Supply Chain Management Practice
- Performed Literature Review of COVID-19 in the World's Supply Chain
    - Defined the main search criterium and generated a keyword-co-occurrence network

October

Cross-Milestone activities - M3 (Risk-guided Platform), M4 (Risk Assessment Model), and M5 (Risk Mitigating Strategies).

- Identified a list of sources of evidence on the impact of COVID-19 on Supply Chains including Scientific databases, News aggregators, Industry reports and Statistics, and Financial data vendors
    - Identified five new premium information aggregators of news sources that TAMUS have already access to.
- Supported the identification of processes and variables interacting in the Risk Assessment Model through the definition of a research hypothesis, methodology, and overall objectives by the use of web scrapping
- Wrote and tested five different web scrapping scripts in R and Python as an initial proof of concept to validate the feasibility of our web scraping hypothesis
- Organized a webinar about the IBIS World COVID-19 Impact Tool (https://my.ibisworld.com/us/en/lists/impact-tool/home)

Milestone 3: Risk-guided Platform

Contributing to Task 3: Generation of the platform for curation and sharing of information collected

- Coordinated access to a two-week trial for Eikon, a Thomson Reuters product
- Assessed Eikon API limitations and python-based gatherers
- Communicated with TAMU libraries account manager to expand our export limit from 100 to 10,000 results per day for ProQuest database
- Started working on the automatization of data acquisition and analysis from publicly available sources
- Generated preliminary results based on a refined query of news for the past month
- Met with subcontractors to accelerate our software development efforts to develop Risk-based analytics

Milestone 4: Risk Assessment Model

Contributing to Task 5: Formulation of risk assessment model using Bayesian Networks

- Updated State-of-the-art Literature Review on the World's Supply Chain Research
- Updated Literature Review of COVID-19 in the World's Supply Chain
    - Defined the main search criterion and generated a keyword-co-occurrence network
- Conducted a Literature Review of COVID-19 impact in the U.S. Supply Chains
- Performed a preliminary analysis on IBIS World COVID-19 Impact Tool

November

Cross-Milestone activities - M3 (Risk-guided Platform), M4 (Risk Assessment Model), and M5 (Risk Mitigating Strategies).

- Identified the most relevant exports and imports of the U.S. through the analysis of trade statistics
- Related export and import products to industries in order to identify the main industrial sectors in the U.S and their impact due to COVID-19
- Performed a preliminary analysis of the historical information of trade statistics regarding:
    - Descriptive statistics of time series of main industrial sectors
    - First and second order statistics of time series per industrial sector
- Secured access to commercially available Panjiva platform for Imports and Exports Information
- Completed assessment of Eikon-Refinitiv Platform. Defined deployment service and agreed on service fees.
- Completed preliminary assessment of Panjiva Platform
    - Designed, developed, and coded initial report for the Panjiva platform
        - Report generation based on Markdown for cross-platform compatibility
        - Currently generating a Markdown, Latex, and HTML output format
        - Mostly compatible with Python, R, C++, and other object-oriented programming languages
- Generated descriptive statistics and first and second order statistics for the following HTS codes using information from the Panjiva platform
    - 6210.10.5000 – PPE
    - 6307.90.6800 – Medical Protective Clothing
    - 6307.99.9889 – N95
    - 9019.20 – Medical ventilators
    - 9022.12 – CT scanners
- Identified relevant ongoing US House Committee & International Trade Commission investigation and points of contacts. The redacted public hearing files are available for the registered public to view, which contain important information related to the project's main focus, including key takeaway concerns and contact information from manufacturers, trade associations, and government officials.
    - Investigation No. 332-580
        - "COVID-19 Related Goods: The U.S. Industry, Market, Trade, and Supply Chain Challenges"
    - Co-Project Leader Samantha DeCarlo (202-205-3165 or samantha.decarlo@usitc.gov)
    - Co-Project Leader Andrew David (202-205-3368 or andrew.david@usitc.gov)
    - Investigation outcomes to be disclosed by Dec. 15th, 2020.
- Completed monthly project status update for the program manager

Milestone 3: Risk-guided Platform

Contributing to Task 3: Generation of the platform for curation and sharing of information collected

- Generated descriptive statistics and first and second order statistics for the following HTS codes using information from the Panjiva platform
    - 6210.10.5000 – PPE
    - 6307.90.6800 – Medical Protective Clothing
    - 6307.99.9889 – N95
    - 9019.20 – Medical ventilators
    - 9022.12 – CT scanners

Milestone 4: Risk Assessment Model

Contributing to Task 5: Formulation of risk assessment model using Bayesian Networks

- Updated a Literature Review of COVID-19 impact in the U.S. Supply Chains
- Developed a preliminary version of the Bayesian Network Model for Risk Assessment through the following steps:
    - Definition of entities, processes and flows of Supply Chains
    - Identification of variables for each risk component, from the literature review and other sources of evidence
    - Construction of a Bayesian Network for the Risk Assessment of Supply Chains
- Developed a minimum viable model and a complete model for different scenarios of Risk Assessment:
    - Scenario 1: All the components of the Supply Chain that are located in the *same* geographical region
    - Scenario 2: All the components of the Supply Chain that are located in *different* geographical regions

Milestone 5: Risk Mitigating Strategies

Contributing to Task 7: Development of a set of qualitatively risk mitigating strategies

- Performed a preliminary identification of mitigating actions oriented to:
    - Reduced the threat intensity
    - Reduce the vulnerability of systems
    - Reduce the overall exposure

IV. Stakeholder Engagement:

Project champion – Tom McGinn DVM, Senior Health Advisor, Countering Weapons of Mass Destruction, Department of Homeland Security.

Main engagement took place at the kickoff meeting and at the presentation of the R-7 and R-13 Data Lake System shared milestone during the first R-13 Taskforce meeting.

V. Transition Progress:

The proposed project poses a significant potential for transition of technology for organizations similar to DHS where decision-making based on mapping of risk is critical. This project aims at

setting the stage to produce a much ambitious platform, user-specific, to be developed on subsequent phases of this project where full quantitative risk assessment and management can be conducted, which opens significant opportunities for transitioning to quantitative simulations of risk scenarios.

VI. Project Risks:

The potential major limitation for a successful completion of the project is the budget and time constraint, which is why this effort is thought as a 'proof of concept' to explore its potential to expand in the future. Due to the pressing need and opportunity provided by COVID19, we limit the milestone to a platform development now jointly defined between R7 and R13 as 'Data Lake System', and to qualitative risk analysis, which would produce the conceptual model for risk assessment and risk management, but would not require its quantitative use. Because of the value of the project to integrate all evidence collected across projects and organizations we anticipate that interest and participation on the project may not pose a significant problem. However, early collaborations across CBTS projects have showed a slow engagement since each project is trying to establish itself leaving little room for cross-collaborations.

VII. Project Timeline:

Figure 3 presents the Project Timeline with the months of activities indicated by the red line. As Figure 3 and the previous sections show, all activities are on schedule, and no delays are presented.

	Today											
	11-24-2020											
Texas A&M University	**Year 1**											
Tasks /Month	1	2	3	4	5	6	7	8	9	10	11	12
Milestone 1. ***Project kickoff***												
Task 1. Engagements with DHS customers and stakeholders												
Output 1. Bi-weekly updates, monthly summaries, and quarterly IPRs												
Milestone 2. ***Data Acquisition and Management Plan in place***												
Task 2. One-on-one interactions with experts representing each component of the trade supply chain infrastructure												
Task 3. Generation of the platform for curation and sharing of information collected												
Milestone 3. ***Risk Guided Platform***												
Output 2. Semi-annual report												
Task 4. One-on-one interactions with experts representing each component of the trade supply chain infrastructure												
Task 5. Formulation of risk assessment model using Bayesian Networks												
Milestone 4. ***Risk Assessment Model***												
Task 6. Education of DHS and participating organizations on the risk-guided platform and the risk assessment model												
Task 7. Development of a set of qualitative risk mitigating strategies												
Output 3. Risk Assessment and Management Bayesian Network including the proposed mitigating strategies												
Milestone 5. ***Risk Mitigating Strategies***												
Output 4. Final report												
Milestone 6. ***Project closeout***												

Figure 1. R7 Project Timeline

VIII. Intellectual Property: If applicable, include a certification that no patentable inventions were created during the budget period.

Not applicable